

Anomocaxe) belong to the Cambrian, and are closely akin to those collected by Richthofen in China. From the Lower Silurian, the *Chasmops* of the Podkamennaya Tunguska is especially worthy of notice. It belongs to the Trentock level, as far as we may judge from corals from the same locality described by Prof. Lindström. Finally, Mr. Schmidt has received from Krasnoyarsk several samples of a new genus, the *Proetus*, which is closely akin to species from the sub-divisions F and G of Barrande.

THE additions to the Zoological Society's Gardens during the past week include a Barbary Ape (*Macacus inuus* ♂) from North Africa, presented by Capt. A. B. Hawes; two Common Badgers (*Meles taxus*) from Staffordshire, presented by Col. E. M. M. Buller; a Red Brocket (*Cariacus rufus* ♂) from Para, presented by Mr. H. E. Weaver; two — Fruit Pigeons (*Carpophaga* —) from the Samoan Islands, presented by Mr. T. H. Bowyer Bower, jun.; a Common Cuckoo (*Cuculus canorus*), British, presented by Mr. G. Lyon Leith; two Tuatera Lizards (*Sphenodon punctatus*) from New Zealand, presented by Mr. L. W. Buller; a Malbrouck Monkey (*Cercopithecus cynosurus* ♂) from West Africa, deposited; a Red-vented Parrot (*Pionus menstruus*) from South America, purchased; a Molucca Deer (*Cervus moluccensis*), a Thar (*Capra jemlaica*), born in the Gardens.

ASTRONOMICAL PHENOMENA FOR THE WEEK, 1885, JULY 5-11

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on July 5

Sun rises, 3h. 53m.; souths, 12h. 4m. 17.6s.; sets, 20h. 15m.; decl. on meridian, 22° 46' N.; Sidereal Time at Sunset, 15h. 11m.

Moon (at Last Quarter) rises, 23h. 25m.*; souths, 5h. 45m.; sets, 12h. 16m.; decl. on meridian, 3° 2' N.

Planet	Rises h. m.	Souths h. m.	Sets h. m.	Decl. on meridian
Mercury ...	4 30 ...	12 45 ...	21 0 ...	23 19 N.
Venus ...	5 13 ...	13 16 ...	21 19 ...	21 28 N.
Mars ...	1 39 ...	9 47 ...	17 55 ...	22 15 N.
Jupiter ...	8 25 ...	15 27 ...	22 29 ...	11 19 N.
Saturn ...	2 55 ...	11 5 ...	19 15 ...	22 32 N.

* Indicates that the rising is that of the preceding day.

July	h.	
9 ...	21 ...	Mars in conjunction with and 5° 7' north of the Moon.
10 ...	23 ...	Saturn in conjunction with and 4° 7' north of the Moon.

GEOGRAPHICAL NOTES

IN concluding his notes on the Kurile islands, to the first instalment of which we have already referred, Prof. Milne has some interesting observations on the geology of this little known archipelago. The two islands, Iturup and Kunashiri, he says, form the two first of the series of stepping stones which connect Japan by means of Kamtschatka with Asia. They seem also to be the older members of the group. They contain a greater proportion of rounded hills and of deeply cut valleys than any of the islands farther north, and may therefore be regarded as older than those which are built up almost entirely of finely formed volcanic cones. The neighbouring island of Urup presents appearances similar to these two. He is inclined to think the formation of an island like Iturup commenced as a number of volcanic peaks forming islands, and that these have been subsequently united by elevation, indications of which there are in the stratified rocks and terrace formations. All the appearances, however, which he has ascribed to a raising of the land, might, he observes, be also explained by a raising and lowering of the sea, such, for instance, as that which Mr. Croll points out, might be produced by the accumulation of ice during a glacial period at the pole; and the fact that the height of the terraces increase

as we go northwards appears to confirm this view. The steepest slope which he has observed in any portion of a volcanic cone was that of a small cone rising from the upper crater of Chacha-nobori, which had an inclination of 37°. This would indicate that it was formed of extremely fine materials, and that the last eruption by which these materials were formed had not been very violent.

IT is announced from Lisbon that the Portuguese explorers, Capello and Ivens, who left Loanda some time ago, have discovered the sources of the Lualaba, Luapula, and Chambeze, the upper waters of the Congo.

AMONG the recent scientific missions ordered by the French Minister of Public Instruction we find the following:—M. Bordas, to study the zoology of the Madagascar Islands, of the Seychelles, and Comoros; M. Clermont-Ganneau, to examine the epigraphy of the islands in the Red Sea, situated at the entrance to the Gulf of Akaba; M. Morgan, mining engineer, on a geological and mineralogical mission in the Orange Free State, the Transvaal, Zululand, and Natal; Lieut. Palat, to explore the route from Senegal to Algeria by Medina, Timbuctoo, Mabrouk, and the Touat.

THE island in the North Pacific which appears now to be definitely added to the British Empire is not, as was at first supposed, Quelpaert, but another Korean island, or rather group of islands, known as Port Hamilton, about forty-five miles to the north-east of the former, and about thirty miles off the Korean coast, in the Broughton Channel, separating the peninsula from Japan. The position of the group is 34° 1' 23" N. lat., and 124° 57' 30" east of Paris. The port is surrounded by three larger islands, and several smaller ones. The largest of all is on the west, and runs from north-west to south-east; it is hilly, but the height of the main eminence is not given by Sir Edward Belcher. Between the two main islands is Observatory Island, and the whole inclose an excellent harbour. The islets, except in one or two channels, which serve as entrances to the bay, are connected by barriers or reefs, above which the water is shallow. The islands are poor in wood, but water is good and abundant, and the sea abounds in fish. There are no cattle, but pigs, fowls, and some vegetables are found. The group was visited in 1846 by Capt. Belcher, and in 1855 by a French frigate.

AT the last meeting of the Geographical Society of Paris Baron Benoist-Méchin described a recent journey in the Merv oasis. This was a continuation of previous communications to the Society of the great journey made by the Baron and some companions from Peking through Manchuria, thence through Siberia, south to Samarkhand, Merv, and so into Persia. M. Simonin made a communication on the pictorial writing of the North American Indians; it appears that, of all the tribes, only the Cherokees and the Creeks possess a writing. The former have newspapers and books in their language, and write with seventy-seven phonetic characters in a syllabary invented by a Cherokee in 1830. The Creeks have nineteen characters. The notorious Sioux chief, Sitting-Bull, has written his autobiography in pictorial writing. His "Caesar's Commentaries" are written on the back of a book which belonged to the Commissariat of the Third United States Infantry Regiment, and contain a recital of his adventures between 1864 and 1870. Each figure is roughly traced in ink, the men and horses being represented as a child might draw them; colours have in some cases been added to render the picture more vivid. The *Comptes Rendus* also contains the continuation of a paper by M. d'Aoust on the causes of earthquakes, and the itinerary of a journey in the basin of the Ruovouma by M. Angelvy, an engineer in the service of the Sultan of Zanzibar.

THE latest *Bulletin* (9^{me} année, No. 2) of the Royal Geographical Society of Belgium is mainly occupied by a paper by M. Hennequin on the agricultural maps of Belgium, with reference to certain maps recently produced by the military cartographic institute for the Ministry of Agriculture. A brief account of Guatemala by M. Leclercq is compiled from the official publications of that republic, and a paper by M. Haron on the commune of Manage (Hainaut) is an interesting study in local geography. It deals, under successive divisions and subdivisions, with the commune on four main heads—physical, economical, and political geography.

THE last *Zeitschrift* of the Berlin Geographical Society contains the following papers:—The conclusion of "Achelis's" article on the methods and task of ethnology; rivers and lakes

as the products of climate, by A. Woeikof, and a map of Paul Acherson's journey in the Libyan desert, with the accompanying descriptive account of the journey.

A LONG-DELAYED letter from the Bishop of Central Oceania gives, *Science* states, details of the honours rendered by the civil and religious authorities to the relics of the companions of La Pérouse. These last survivors of that unfortunate expedition were massacred by the Samoans on the Islet of Tutuila on December 11, 1787. Father Vidal, of the mission, had been searching twelve years for the remains, which were finally identified in October, 1882. The authorities in France, on being notified, caused a beautiful mortuary tablet to be prepared, and forwarded to the admiral on duty at that station. A monument was erected, upon which the tablet was fixed, and a small chapel built near it. The whole was dedicated by Bishop Lamaze and Commandant Fournier, of the French Navy, with solemn ceremonial and minute-guns on the ninety-seventh anniversary of the event.

LIQUID FILMS¹

THE molecules in the interior of a liquid are surrounded on all sides by others which they attract, and by which they are themselves attracted, while those on the surface have neighbours on one side only. In consequence of this difference in their surroundings there is in all probability a difference in the grouping of the interior and exterior molecules which is attended by corresponding variations in the physical properties of the liquid of which they are constituent parts. Thus it was shown by M. Plateau that the viscosity of the surface of a liquid is in general different from that of its interior. The most striking example of this phenomenon is afforded by a solution of saponine. Two per cent. of this substance dissolved in water does not effect any marked change in the properties of the great mass of the liquid, but produces a most remarkable increase in the surface viscosity, so that forces which suffice to create rapid motion in bodies which are completely immersed, fail to produce any appreciable movement if they lie in the exterior surface. The first attempt to obtain a numerical estimate of the difference of the resistances experienced by a body oscillating in turn in the interior and in the surface of the liquid was made about two years ago by Messrs. Stables and Wilson, students in the Yorkshire College. In the case of a horizontal disc suspended in water, the logarithmic decrement diminishes to about one half as the surface is approached. In a saponine solution, on the other hand, it is 125 times greater in the surface than in the interior, and about 38 times greater in the surface than at a depth of 0.1 mm. below it. Even in the latter case the greater part of the resistance is due, not to the friction between the disc and the liquid, but to that experienced by the supporting rod in the surface, so that in all probability the surface viscosity is more than 600 times greater than that of the mass of the liquid.

The immense change in the resistance which takes place when the disc is immersed to a depth of 0.1 mm. only confirms the general opinion that any peculiarity of grouping or arrangement due to proximity to the surface extends to a very small depth. A liquid must thus be conceived as surrounded by a very thin layer or skin, the properties of which are different from that of the liquid in the interior, and to which rather than to any ideal geometrical boundary the term "surface" might be applied. It may, however, prevent confusion if it is called the *surface-layer*.

Many attempts have been made to measure the thickness of the surface-layer. In particular, M. Plateau studied a thinning soap film with a view of determining whether or no the pressure exerted on the enclosed air by the film when very thin is the same as when it is comparatively thick. Had any such difference been observed it might have been taken as *prima facie* evidence that the tenuity was so great that all the interior portions of the film had drained away, and that the thickness did not exceed that of the two surface-layers.

This experiment has been criticised by Prof. Reinold and myself, but it is not intended in this lecture to enter upon the general question of the thickness of the surface-layer, or the interesting theoretical problems which are closely connected with it, as we are at present engaged in an investigation which we hope may throw further light upon the subject. There are, however, two preliminary questions on which we have arrived at definite conclusions.

In any experiments which have for their object the detection of small changes in the properties of a soap film as it becomes thinner, it is essential that we should be able to assert with certainty that no causes other than the increasing tenuity have been in play, by which the effect looked for might either be produced or masked. Changes in the temperature or composition of the film must especially be prevented.

The liquid ordinarily employed for such investigations is the "liquide glycérique" of M. Plateau. In dry air some of the water of which it is in part composed would evaporate, while in moist air, in consequence of the hygroscopic properties of the glycerine, additional water would be absorbed. Though these facts were well known, and though they are evidently possible sources of error, no attempt (as far as I am aware) had been made before our own to determine what precautions it was necessary to take to prevent the results of experiments such as M. Plateau's being affected by them. The first question then that we set ourselves to answer, was—to what extent is the composition of a soap film altered by changes in the temperature or hygroscopic state of the air which surrounds it?

The method adopted in answering this inquiry was to measure the electrical resistance of soap films formed in an inclosed space containing a thermometer and hair hygrometer. If the observations led to the conclusion that the resistance of film varied inversely as its thickness, they would prove that no change in composition had taken place, and that the film at the thinnest had afforded no evidence of an approach to a thickness equal to that of the surface-layers. If the specific resistance was found to vary according to some regular law as the thickness altered, there would be a strong presumption that the thickness was not much greater than, and was possibly even less than that of the two surface-layers. If, lastly, the changes were irregular, they might safely be ascribed to alterations in temperature or constitution.

To obtain the desired facts it was necessary (1) to devise a method of forming the films in a closed chamber, (2) to measure their thickness, and (3) to determine their electrical resistance.

The films were formed in a glass box at the lower extremity of a platinum ring which communicated by means of a tube with the outside. In the earlier experiments a cup of the liquid was raised by rackwork to the ring and then withdrawn, leaving a film behind it. The latter was blown out by air which had been dried and passed through tubes containing "liquide glycérique." When large enough it adhered to a second platinum ring placed vertically below the first, and on some of the air being withdrawn it assumed the cylindrical form.

The thickness was measured by means of the colours displayed, two independent determinations being obtained by two beams of light incident at different angles. Newton's Table of Colours was revised, and it was found that the differences between the thicknesses given by him and those determined by new experiment were far greater than the error of experiment of a single observer. Hence, if accurate measurements are required by means of Newton's scale, every experimenter must reconstruct that scale for himself.

At first the electrical resistance was determined by means of Wheatstone's bridge. The edges of the film where it is close to its solid supports are often, however, the seat of phenomena which might affect the results. Thin rings of white or black appear which alter the resistance considerably, and which introduce errors for which it is almost impossible to make any accurate allowance. This fact, combined with the advantage of avoiding errors due to polarisation, and of being able to select any particular part of the film for examination instead of the whole, led us to adopt a different method. Gold wires attached to a movable support were thrust into the film, and the difference of potential between these when a current was passing through the film was compared with that between the extremities of a known resistance included in the same circuit.

The result of these observations was to prove that the specific resistance of the films altered in an irregular manner, varying between 200 and 137 ohms per cubic c.m. A closer inspection showed that abnormal results were always accompanied by abnormal variations in the thermometer or hygrometer. When those films were selected which had been observed when such variations were especially small, it was found that the range of variation of the specific resistances was only between 137 and 146, and that the mean value was 143, that of the liquid in mass being 140.5 (at the same temperature). It was also proved that between thicknesses varying from 1370 to 374 millionths of a

¹ Lecture at the Royal Institution by Prof. A. W. Rücker, M.A., F.R.S.